Solar Buildings Program

Technology Overview

Solar buildings technologies use the nonpolluting power of the sun to help heat, cool, and power our buildings. Solar collectors that absorb the sun's heat are at the heart of most active solar energy systems. This thermal energy is used to provide heated water for residential or commercial use, to provide space heating, or for many other applications where fossil fuels might otherwise be used.

Three common applications are residential solar water heating, residential and commercial swimming pool heating, and commercial ventilation preheating using transpired air collectors.

Solar water heaters use the sun to heat either water or a heat-transfer fluid in collectors, with a conventional system providing supplemental heating. A typical system will reduce the need for conventional water heating by about two-thirds, minimizing the cost of electricity or fossil fuel and the environmental impacts associated with their use.

Solar swimming pool heaters use a pool's existing filtration system to pump water through solar collectors and then back into the pool. Because solar pool-heating collectors operate just slightly warmer than the surrounding air temperature, these systems typically use inexpensive, unglazed low-temperature collectors made from specially formulated plastic materials. When installed on previously unheated pools, solar systems can extend the pool usage season by several months.

Transpired air collectors are made of dark, perforated metal. The sun heats the metal, and a fan pulls ambient air through the holes in the metal, which heats the air. These collectors are used for preheating ventilation air and for crop drying. Transpired air collectors are easily incorporated into standard commercial building ventilation systems, and offer a highly cost-effective opportunity to substitute renewable energy for fossil fuel consumption.

Solar Design Associates, Inc./PIX08563

This Maine home integrates energy efficiency and renewable energy technologies, including solar radiant floor and water heating. Through a net-metering relationship with Central Maine Power, surplus solar electricity is exported to the utility grid, effectively spinning the utility meter backward.

U.S. Department of Energy Program

The mission of the U.S. Department of Energy (DOE) Solar Buildings Program is to develop zero energy buildings (ZEB)s) which combine solar energy technologies with very energy-efficient building design and appliances, to create a new generation of cost-effective buildings that have a zero net need for offsite energy.

The program's zero net energy vision is that, by the year 2010, the United States will be constructing a significant number of buildings that:

- Meet their own energy needs by utilizing solar or other renewable resources.
- Have no on-site or off-site carbon emissions.
- Reduce utility peak electrical demand.
- Optimize the health and productivity of their occupants.
- Provide energy security from natural disasters and extended power outages.

The DOE Solar Buildings Program focuses on public-private partnerships to realize this vision, while continuing to support research and development of solar buildings technologies that contribute to a zero energy building. Two national laboratories (the National Renewable Energy Laboratory and Sandia National Laboratories), several universities, and numerous industry partners work collaboratively on these activities. Researchers are now investigating the use of low-cost plastic materials in the design of the "next-generation" solar water heater.

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The Solar Energy $olution

The Hawaiian Electric Company's (HECO's) Energy$olutions program is the largest ongoing solar water heating program in the United States. It has resulted in more than 6000 solar installations since 1996. Energy$olutions is attractive to homeowners because it offers them an $800 rebate on the cost of installing a solar water heater, as well as a five-year parts and labor warranty. The program is attractive to HECO because it helps lower peak electrical demand. This is especially significant because of Hawaii's high cost of electricity (12 cents per kilowatt-hour).

Hawaiian Electric Co., Inc./PIX05573

In partnership with the Hawaiian Electric Company, the U.S. Navy installed 136 solar water-heating systems on residences in its Moanalua Terrace family housing project. Each system offsets about 1.7 tons of carbon dioxide, 8.2 pounds of sulfur dioxide, and 11.2 pounds of nitrogen oxide every year.

Market Potential

Today's buildings use a third of the energy currently consumed in the United States and are responsible for two-thirds of peak electrical demand. Because of this, the potential for using solar thermal technologies to reduce utility peak loads in place of conventional gas- or electric-based technologies is substantial.

Key U.S. markets for solar water heaters include California, Arizona, Nevada, Hawaii, and Florida. These states have an excellent solar resource. Hawaii and California are particularly well suited for solar because of their higher conventional fuel prices. In fact, solar water heating is competitive, in many markets, with natural gas and electric water heaters due to higher energy prices.

The market for solar pool-heating systems has been strong over the years, with approximately 25,000 systems sold in the United States in 1999. This number represents about one-fifth of all pool heaters sold annually. Solar pool heaters often pay for themselves in two to four years when replacing a conventional pool heater.

Ventilation air preheating is a universal need in cold climates, as well as a major user of energy. Transpired air collectors pay for themselves quickly and produce substantial environmental and economic benefits with no negative side effects. Transpired air collectors have been employed at many locations, including apartment buildings, warehouses, large manufacturing plants, and airplane maintenance hangars.

In Lakeland, Florida, a prototype zero energy home outperformed a conventional model by providing almost all of its power needs throughout the year. This research project shaved summer peak electricity demand by 95%. In fact, the prototype ZEB home sold much faster than the conventional home built to traditional building codes and standards.

For More Information:

DOE Solar Buildings Program
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